

Peanut Butter & Jelly Robot

Students learn the basic concepts of writing a computer program by designing step-by-step instructions for a common activity.

SCIENCE TOPICS

Logic
Computer Programming
Robotics
Controls
Troubleshooting

PROCESS SKILLS

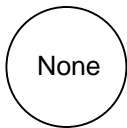
Logical thinking
Testing
Troubleshooting
Problem Solving
Communicating
Following Instructions
Using symbols

GRADE LEVELS

K-5

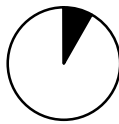
TIME REQUIRED

Advance Preparation



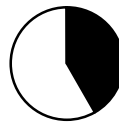
15 minutes
(first time only)

Set Up



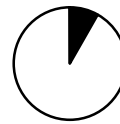
5 minutes

Activity



25 minutes

Clean Up



5 minutes

SUPPLIES

- 1 jar of peanut butter

SAFETY PRECAUTION: IN CASE OF PEANUT ALLERGIES, USE SOY BUTTER.

- ❑ 1 butter knife
- ❑ 1 jar of jelly
- ❑ 1 loaf of bread
- ❑ Cleaning supplies (spray cleaner, towels), drop cloth
- ❑ Chalkboard, whiteboard, or flip chart
- ❑ Chalk or pens
- ❑ Optional: Robot props. (funnel hat, etc.)

ADVANCE PREPARATION

- ❑ Clear an area, or lay down a drop cloth for easy clean up.
- ❑ Read the procedure. If you have never done this activity before, practice the activity with an adult.

SET UP

- ❑ Set out the peanut butter, jelly, bread and knife on a table near a chalkboard, whiteboard, or flip chart.
- ❑ Set the cleaning supplies nearby.

INTRODUCING THE ACTIVITY

Let students speculate before offering answers to any questions. The answers at the right are provided primarily for the teacher's benefit.

Ask the students the following questions in **bold**. Possible student answers are shown in *italics*.

What is a robot?

Robots:

- *Are controlled by people.*
- *Can be reprogrammed to do something new.*
- *Move around.*
- *Use sensors to measure their surroundings.*

How do robots know what to do?

Robots are controlled by computers. The computers follow programs that people write.

Ask the students if they know how to make a peanut butter and jelly sandwich.

Explain to the class that they are going to write instructions to program a robot to make peanut butter and jelly sandwiches. Point out the supplies: a loaf of bread, a jar of peanut butter, a jar of jelly, and a knife.

Introduce the “robot” to the class. (The teacher or a class assistant will be the robot.)

CLASSROOM ACTIVITY

Note: This is intended to be a silly activity. Students will come up with instructions. Try to follow the “literal” directions, not the students’ intended meaning. The more imagination you have for “misunderstanding” ambiguous instructions, the more fun this activity will be for all. For ideas, try watching “Mr. Noodle” in Elmo’s World™ on Sesame Street™. This activity is intended to be in that style.

For example:

If the students say:	You should:
<i>“Get two pieces of bread.”</i>	Rip open the bag in the middle, and tear two crouton-sized lumps off of one slice.
<i>“Put the peanut butter on the bread.”</i>	Crush the bread with the jar of peanut butter.
<i>“Pick up the knife.”</i>	Pick it up from the blade end, not the handle.
<i>“Scoop out some peanut butter”</i>	Use your hand if they don’t specify the knife.

The more creative you can be in “misunderstanding” the instructions, the better the activity.

Procedure for Peanut Butter & Jelly Robot

1 Ask the students to give the robot instructions.

- **The robot must follow the students' instructions exactly.**
- The instructions will be unclear and steps will be missing (like using a knife, or the bread).
- Remind the students to speak one at a time, and encourage participation from all.

2 As students create instructions, you will write them down.

- (It is handy if you have an adult helper, so one adult can be the robot, and the other writes the instructions down.)
- Create two lists of instructions, one for robots and one for people who didn't know how to make a sandwich.
- For each instruction, write down the commands it took for the robot to correctly finish the task, showing all the detail that was required.
- Contrast these instructions with the human steps, showing how people can interpret and understand vague or unclear commands.

Students will naturally say instructions that work better for humans. At each step, you will:

- Mess up the instruction.
- Record the instruction as a good example of a human instruction.
- Have the students revise the instruction.
- Follow the revised instruction **exactly**.
- Repeat until the instruction is extremely precise.
- Record the good robot instruction.

3 Continue until the class has successfully made instructions for a peanut butter and jelly sandwich.

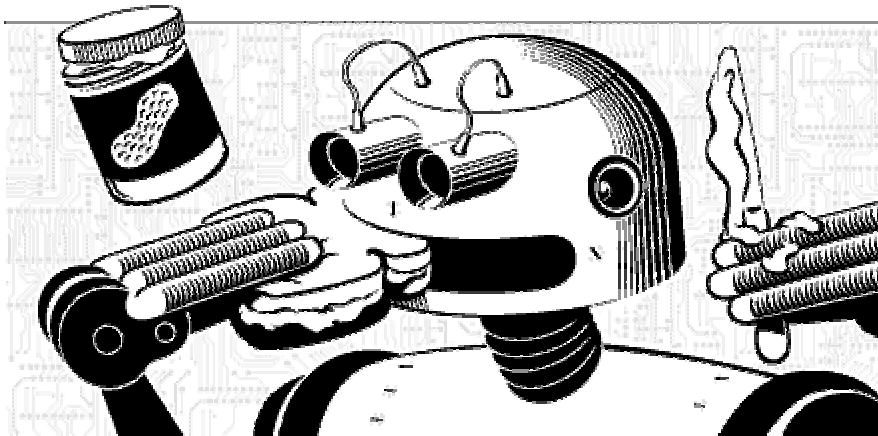


Image from: <http://www.eweek.org/site/DiscoverE/activities/pbnj.shtml>

EXPLANATION

*In-depth background information for teachers
and interested students.*

Are computers smart?

No – machines can't be smart or dumb. Their actions can seem "smart", such as when the robot follows complex tasks. That "artificial intelligence" is a person's intelligence, which was programmed into the computer.

Computers are only as good as the instructions they receive from people. Human computer programmers strive to translate human language into a code that a machine can recognize and understand. Successful programming requires that a task be broken down into steps that can be understood not only by the computer, but also by other programmers. This set of steps is called an algorithm. An algorithm is a procedure for performing a task by carrying out a precise sequence of simple, unambiguous steps.

Robots can't do anything unless a person programs them. As this activity shows, people must be very careful when programming the robot. Robots can't think about whether they're going to do something destructive or harmful: they will always do exactly as they're told, even if the person made a mistake in the program.

Why do people use robots?

You can also build robots that can pick up an entire car, something no person could ever do. Robots are also valuable tools to explore places too dangerous for people. We send robots into volcanoes, the ocean, and outer space.

Robots are very good at repeating things over and over. Once a program is written, a robot can repeat it for a long time. A robot that is programmed to build a car can build a million identical cars. If people made a million cars, they would be much more inconsistent. And while robots need power and maintenance, robots don't get tired or need bathroom breaks.

We see that robots are good at repetition in this activity. Point out how similar the jelly instructions are to the peanut butter instructions. Instead of creating two sets of parallel instructions, you can simply write, "Do the same with jelly that you did with peanut butter". The "spreading" algorithm can be repeated.

This activity is metaphoric

Robots can't listen to people shouting instructions at them. They don't understand English. Programming is done in computer code. But this lesson would take forever if we made students use computer commands.

A real robot's program would look like this:
Rotate elbow 90 degrees left.
Open hand.
Rotate wrist clockwise 15 degrees.
Close hand.

We let the students' commands be things like:
Pick up knife by the fat end.
Take lid off peanut butter.
Spread on the white part of the bread.

CROSS-CURRICULAR CONNECTIONS

LANGUAGE ARTS	Have students write a program for a simple task, such as tying your shoes or putting on a coat.
ENGINEERING	Have the class participate in the First LEGO League Challenge competitions. Visit a facility that uses robotics in its production process.
SOCIAL STUDIES	Set up an interview or visit with a computer technician, programmer, or engineer.